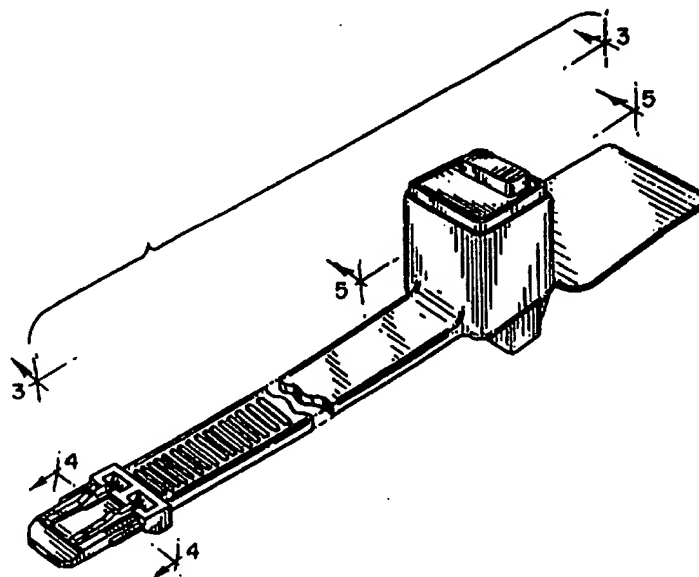


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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: <b>PCT/US95/13117</b> (22) International Filing Date: 20 October 1995 (20.10.95) (30) Priority Data: 08/326,600 20 October 1994 (20.10.94) US (71) Applicant: AMERICAN CASTING AND MANUFACTURING CORPORATION [US/US]; 51 Commercial Street, Plainview, NY 11803 (US). (72) Inventor: WENK, Joseph, H., C.; Charlemagne Road, Huntington Bay, NY 11743 (US). (74) Agent: KAMMER, A., Thomas; Hoffmann & Baron, 350 Jericho Turnpike, Jericho, NY 11753 (US).	(81) Designated State: GB.  Published <i>With international search report.</i>	

(54) Title: TAMPER-PROOF CARGO SEAL



## (57) Abstract

A tamper-resistant seal (10) for securing cargo container doors, overseas shipping containers and the like is provided. The seal includes a housing (16) including a strap engagement assembly (22). An elongate strap (18) is coupled to the housing and includes a free end (24) insertable within the housing. The free end of the strap is engageable with the strap engagement assembly. A first locking device is mounted to the free end of the strap (28). The locking device includes a body portion which is suspended such that it is deflectable upon insertion within the housing and engagement with the engagement assembly. The strap further includes ratchet teeth (34) which are engageable with a complementary set of ratchet teeth (64) provided within the housing.

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**TAMPER-PROOF CARGO SEAL****BACKGROUND OF THE INVENTION****1. Field of the Invention**

5 The field of the invention relates to tamper-resistant seals for securing cargo container doors, overseas shipping containers and the like.

**2. Brief Description of the Related Art**

10 It is often important to ensure that cargo shipped in trucks or containers has not been tampered with prior to arrival at its intended destination. In addition to locking the contents within the trucks or containers, tamper-resistant seals may be employed. Such seals should be locked permanently, and exhibit visible damage if opened at any point in time.

15 Various seals have been designed for securing containers and other equipment. U.S. Patent Nos. 3,146,012, 3,372,952 and 4,674,778 disclose examples of such seals.

20 Other seals have been specifically designed for securing bags. Such seals generally allow the strap portions of the seal to be pulled entirely through the locking portions thereof in order to cinch the bag opening. Cargo seals do not require this feature, and the strap can and generally does terminate at the locking mechanism. Two  
25 types of bag seals are disclosed in U.S. Patent No. 4,676,535 and commonly assigned U.S. Patent No. 5,123,686, respectively.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a tamper-proof seal for containers of various types.

5 It is another object of the invention to provide a seal which will readily exhibit evidence of tampering upon attempts to open the seal.

A still further object of the invention is to provide a seal which can be easily locked by the user, but which is substantially impossible to unlock without damaging the  
10 seal.

A tamper-proof seal is provided which accomplishes the above-listed objects of the invention, and which provides additional advantages as discussed in the detailed description which follows. The seal includes a housing  
15 having a strap engagement assembly. An elongate strap is coupled to the housing, and includes a free end which is insertable within the housing. A locking device is mounted to the free end of the strap, and is engageable with the strap engagement assembly. The locking device extends  
20 above the upper surface of the free end of the strap, and is deflectable towards the upper surface upon insertion within the housing.

The free end of the strap preferably includes a pair of locking devices, each of which extends parallel to the  
25 longitudinal axis of the strap. A projection preferably extends from the bottom surface of the free end of the strap. This projection blocks the opening to the housing, and increases the difficulty of opening the seal without leaving evidence of tampering.

30 The bottom surface of the free end of the strap also preferably includes a plurality of teeth. A teeth

engagement member is provided within the housing, and helps prevent withdrawal of the free end of the strap from the housing.

**BRIEF DESCRIPTION OF THE DRAWINGS**

5        Fig. 1 is a top perspective view of a seal according to the invention as applied to a closure;

Fig. 2 is a top perspective view of the seal assembly prior to deployment;

10       Fig. 3 is a sectional view taken along line 3-3 of Fig. 2;

Fig. 4 is a sectional view taken along line 4-4 of Fig. 2;

Fig. 5 is a sectional view taken along line 5-5 of Fig. 2;

15       Fig. 6 is a partially exploded, top perspective view thereof;

Fig. 7 is a sectional view taken along line 7-7 of Fig. 6;

20       Fig. 8 is a sectional view of a housing of the seal with the free end of a strap inserted therein;

Fig. 9 is a top plan view of the seal;

Fig. 10 is a bottom plan view thereof;

Fig. 11 is an end view of a strap teeth engagement assembly;

Fig. 12 is a side elevation view thereof; and

Fig. 13 is a top plan view thereof.

#### DETAILED DESCRIPTION OF THE INVENTION

A tamper-proof seal 10 is provided for sealing  
5 containers of various types, such as cargo containers and  
other containers or storage vessels where evidence of  
tampering by unauthorized persons is desired. Fig. 1 shows  
the seal 10 in one such application where it extends  
through the aligned openings of a pair of tabs 12 mounted  
10 to the doors 14 of a container. The seal 10 is constructed  
such that it is simple to apply to a container, and will  
provide obvious evidence that it has been opened or  
tampered with.

As shown in Figs. 2 and 3, the seal 10 according to  
15 the preferred embodiment of the invention includes a  
housing 16, an elongate strap 18 extending from one wall of  
the housing, and a tab 20 extending from another wall of  
the housing. The tab 20 is an optional feature. The strap  
and housing may be integrally formed from a semi-rigid  
20 polymeric material such as polypropylene having a Rockwell  
hardness of at least about R100.

A strap tooth engagement assembly 22 is positioned  
within the housing, and permanently secured thereto. This  
assembly is substantially identical to that disclosed in  
25 U.S. Patent No. 5,123,686, the disclosure of which is  
incorporated by reference herein.

The strap 18 has a generally flat configuration and  
terminates in a free end 24 which is insertable within the  
housing 16. The upper surface of the strap includes a  
30 plurality of parallel ridges 26 adjacent the free end 24 to  
facilitate handling. (Terms such as "upper" and "lower"  
are relative terms, and are used simply to define the

relative positions of various features of the invention).

The free end of the strap includes first and second locking devices 28. Each locking device includes a body portion including first and second end portions 28A, 28C  
5 connected to the substantially flat body of the free end of the strap. A central portion 28B connects the end portions 28A, 28C, as shown in Fig. 3. The free end of the strap includes a pair of parallel, elongate slots 30. Each slot is located beneath one of the central portions 28B of a  
10 locking device. These central portions 28B are accordingly deflectable towards the upper surface of the strap when pressure is exerted thereon. The free end 24 of the strap is relatively wide near the slots to compensate for the reduction in the strength of the strap due to the presence  
15 of the slots.

The central portion 28B of each locking device includes a locking member 32 having a generally saw-toothed configuration. The front or insertion end of the locking member is inclined with respect to the upper surface of the  
20 strap, while the rear end extends substantially perpendicularly thereto. Each locking member extends above the plane of the upper surface of the strap. The elongate body portions of each locking device 28 run substantially parallel to the longitudinal axis of the strap when the  
25 strap is in the position shown in Figs. 2-3.

The bottom surface of the free end of the strap includes a plurality of ratchet teeth 34. The bottom edges of the teeth are coplanar with the flat portions of the bottom surface. A lateral projection 36 including an  
30 inclined front surface 36A also extends downwardly from the bottom surface. This projection equals the maximum width of the free end of the strap, and includes a flat rear surface 36B extending perpendicularly to the strap bottom surface.

The housing 16 is integral with the strap, and includes a generally cubic main housing portion and a strap entrance chute 74. Referring to Fig. 9, the main housing portion includes four adjoining side walls 38 and an end wall 40. A pair of L-shaped members 42 and one of the side walls define a channel 44. Three elongate projections 46, 48, 50 extend from the side wall opposing the L-shaped members 42. A pair of opposing walls 52 extend from the L-shaped members 42. Each of these opposing walls 52 include an inclined surface 52A.

Referring now to Fig. 5, a lateral wall 54 having an inclined surface connects the opposing walls 52 near the end wall 40 of the housing. A portion of the end wall 40 adjoining one of the side walls defines a pair of shoulders 56 positioned between the respective elongate projections 46, 48, 50.

The strap tooth engagement assembly 22 is preferably integrally molded. Referring to Figs. 7-8 and 11-13, this member includes a first wall 58 which mates with the open side of the housing 16. The wall 58 is solid in construction.

A second wall 62 extends substantially perpendicularly from the first wall 58 of the tooth engagement assembly 22, forming a substantially L-shaped configuration. A teeth locking member 64 is secured to the second wall 62 by a pair of resilient, deformable legs 66. It includes a wedge-shaped end 68 extending beyond the resilient leg 66 farthest from the first wall 58. A pair of laterally extending wedges 70 are integral with opposite sides of the teeth locking member 64. The inclined surfaces defined by the wedges 70 are substantially coplanar, and are generally parallel to the inclined end surface of the wedge-shaped end 68. The locking member 64 includes ratchet teeth 72 designed for engaging the ratchet teeth 34 at the free end



24 of the strap 18.

The tooth engagement assembly 22 and housing 16 are dimensioned such that, when the former is inserted into the latter, the wedge-shaped end 68 of the teeth engagement member engages the inclined surface of the lateral wall 54. The wedges 70 engage the inclined surfaces 52A of the opposing walls 52 of the housing. The engagement of these surfaces causes the locking member 64 to be urged away from the second wall 62 when a force is applied towards the end wall 40 of the housing 16. Such a force is typically applied when one attempts to remove the free end of the strap from the housing.

A generally rectangular chute 74 is integral with the housing 16, and defines an opening through which the free end 24 of the strap is inserted within the housing. As shown in Fig. 10, a pair of parallel channels 76 are defined within the upper wall of the chute. The channels function as a guide when the free end of the strap is inserted and the locking members 32 slide therethrough. The exterior portion of the housing end wall 40 includes an upper surface which engages the inclined front surface 36A of the strap projection 36 when the free end 24 thereof is substantially fully inserted within the housing 16. The wedging action between these surfaces prevents the strap from being pushed towards the wall 58 beyond the position shown in Fig. 8. A plurality of ribs 78 connecting the chute and housing add rigidity to the construction.

In use, the strap 18 is inserted through an opening in a closure, such as the opening defined by tabs 12 in Fig. 1. The free end 24 of the strap 18 is then inserted within the housing, where it is permanently locked. As the free end 24 of the strap is inserted, the locking devices 28 are deflected slightly towards the respective slots 30. Once the locking members move past the shoulders 56 within the

housing, they snap back to their rest positions as shown in Fig. 8. The ratchet teeth 34 of the strap engage the ratchet teeth 72 of the locking member 64. The legs 66 of the teeth engagement member 22 resiliently urge the locking member towards the strap.

Should one attempt to pull the free end 24 of the strap from the housing, the combination of the engaged ratchet teeth 34, 72 and abutment of the locking members 32 against the housing shoulders 56 provides such a strong retentive force that the strap breaks before the free end 24 can be decoupled. This is accomplished without building a weakened portion into the strap, which is necessary in some prior art designs having less effective locking mechanisms. The resilient legs 66 cause the locking member 64 to move into even stronger engagement with the strap as they straighten from the positions shown in Fig. 8 as the strap is pulled in the direction opposite from the arrow. Clear evidence of tampering will accordingly be provided should a sufficient force be applied to the seal 10.

Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various other changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

**WHAT IS CLAIMED IS:**

1. A tamper-proof seal for securing an enclosure, comprising:

a housing including a strap engagement assembly;  
an elongate strap coupled to said housing, said

5 strap including a free end insertable within said housing  
and engageable with said strap engagement assembly;

said free end of said strap including a generally  
flat body having relatively wide upper and lower surfaces  
and relatively narrow edges connecting said upper and lower  
10 surfaces;

a first locking device mounted to said free end  
of said strap, said locking device including a body portion  
having first and second end portions connected to said  
generally flat body, a central portion connected to and  
15 suspended between said first and second end portions, and  
a locking member extending from said central portion and  
above said upper surface,

said central portion of said locking device being  
deflectable in a direction generally perpendicular to said  
20 upper surface upon engagement of said locking member with  
said strap engagement assembly.

2. A seal as described in Claim 1, wherein said  
elongate strap has a longitudinal axis and said body  
portion of said first locking device is elongate and  
extends substantially parallel to said longitudinal axis.

3. A seal as described in Claim 2, wherein said  
locking member is integral with said central portion of  
said first locking device and has a generally saw-toothed  
configuration.

4. A seal as described in Claim 3, wherein said  
lower surface of said free end of said strap includes a  
plurality of teeth and said housing includes a teeth

engagement member which is engageable with said teeth upon insertion of said free end of said strap into said housing.

5. A seal as described in Claim 4 including means for resiliently urging said teeth engagement member into engagement with said teeth.

6. A seal as described in Claim 5, wherein said strap engagement assembly includes a shoulder integral with said housing which engages said locking member upon attempted withdrawal of said free end of said strap from  
5 said housing.

7. A seal as described in Claim 2, wherein said free end of said strap includes a second locking device extending substantially parallel to said first locking device and having substantially the same construction as  
5 said first locking device.

8. A seal as described in Claim 7, wherein said respective locking members are integral with said respective central portions of said locking devices and have generally saw-toothed configurations.

9. A seal as described in Claim 8, wherein said lower surface of said free end of said strap includes a plurality of teeth and said housing includes a teeth engagement member which is engageable with said teeth upon  
5 insertion of said free end of said strap into said housing.

10. A seal as described in Claim 1, wherein said housing includes a generally rectangular opening for receiving said free end of said strap, said free end of said strap including an integral, lateral projection  
5 extending downwardly from said lower surface and substantially between said edges, said strap and said lateral projection substantially closing said rectangular

opening upon insertion of said free end of said strap into said housing.

11. A seal as described in Claim 10, wherein said housing includes an abutment for engaging said lateral projection.

12. A tamper-proof seal comprising:

a housing including a strap engagement assembly;

an elongate strap coupled to said housing, said strap including a free end insertable with said housing and engageable with said strap engagement assembly;

said free end of said strap including a generally flat body having relatively wide upper and lower surfaces and relatively narrow edges connecting said upper and lower surfaces; and

a first locking device movably coupled to said free end of said strap and extending above said upper surface thereof, said locking device being deflectable towards said upper surface upon engagement with said strap engagement assembly.

13. A seal as described in Claim 12, wherein said elongate strap has a longitudinal axis, said first locking device including an elongate body portion extending substantially parallel to said longitudinal axis.

14. A seal as described in Claim 13, wherein said free end of said elongate strap includes a second locking device extending substantially parallel to said first locking device and having substantially the same construction as said first locking device.

15. A seal as described in Claim 14, wherein each of said locking devices includes a locking member extending upwardly from said elongate body portion, said locking members having generally saw-toothed configurations.

16. A seal as described in Claim 14, wherein said lower surface of said free end of said strap includes a plurality of teeth and said housing includes a teeth engagement member which is engageable with said teeth upon  
5 insertion of said free end of said elongate strap into said housing.

17. A seal as described in Claim 16 including means for resiliently urging said teeth engagement member into engagement with said teeth.

18. A seal as described in Claim 12, wherein said housing includes a generally rectangular opening for receiving said free end of said elongate strap, said free end of said elongate strap including an integral, lateral  
5 projection extending downwardly from said lower surface and substantially between said edges, said elongate strap and said lateral projection substantially closing said rectangular opening upon insertion of said free end of said elongate strap into said housing.

19. A seal as described in Claim 13, wherein said elongate body portion of said locking device includes a pair of end portions integral with said upper surface and a central portion suspended between said end portions, said  
5 central portion including a locking member having an inclined front surface and a rear surface, said housing including a shoulder which adjoins said rear surface when said free end of said elongate strap is positioned within said housing.

20. A seal as described in Claim 13, wherein said free end of said elongate strap includes an elongate slot extending substantially parallel to said longitudinal axis, said elongate body portion of said first locking device  
5 extending at least partially over said elongate slot.

21. A tamper-proof seal for securing an enclosure, comprising:

a housing;

5 a strap tooth engagement assembly positioned within said housing, said strap tooth engagement assembly including a locking member including a plurality of ratchet teeth and means for resiliently supporting said locking member;

an opening defined within a wall of said housing;

10 an abutment surface defined by said housing;

an elongate strap coupled to said housing, said elongate strap including a free end insertable within said housing through said opening and between said locking member and abutment surface;

15 a plurality of ratchet teeth defined by a lower surface of said free end of said elongate strap and engageable with said ratchet teeth of said locking member; and

20 a locking device extending from an upper surface of said free end of said strap, said locking device including a rear surface which opposes said abutment surface when said free end of said elongate strap is inserted within said housing.

22. A seal as described in Claim 21, wherein said locking device includes an inclined front surface.

23. A seal as described in Claim 21, including a projection extending from the lower surface of said free end of said elongate strap, said housing including an end wall engageable with said projection to limit the extent to  
5 which said free end of said strap can be inserted within said housing.

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FIG-1

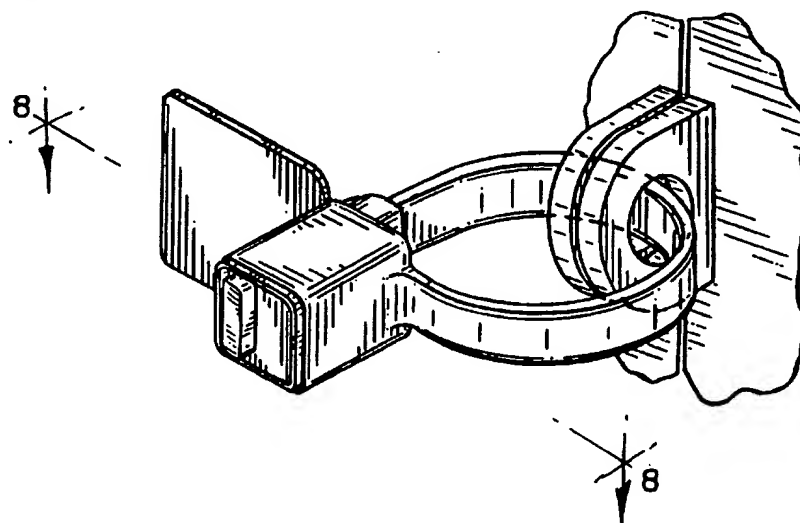
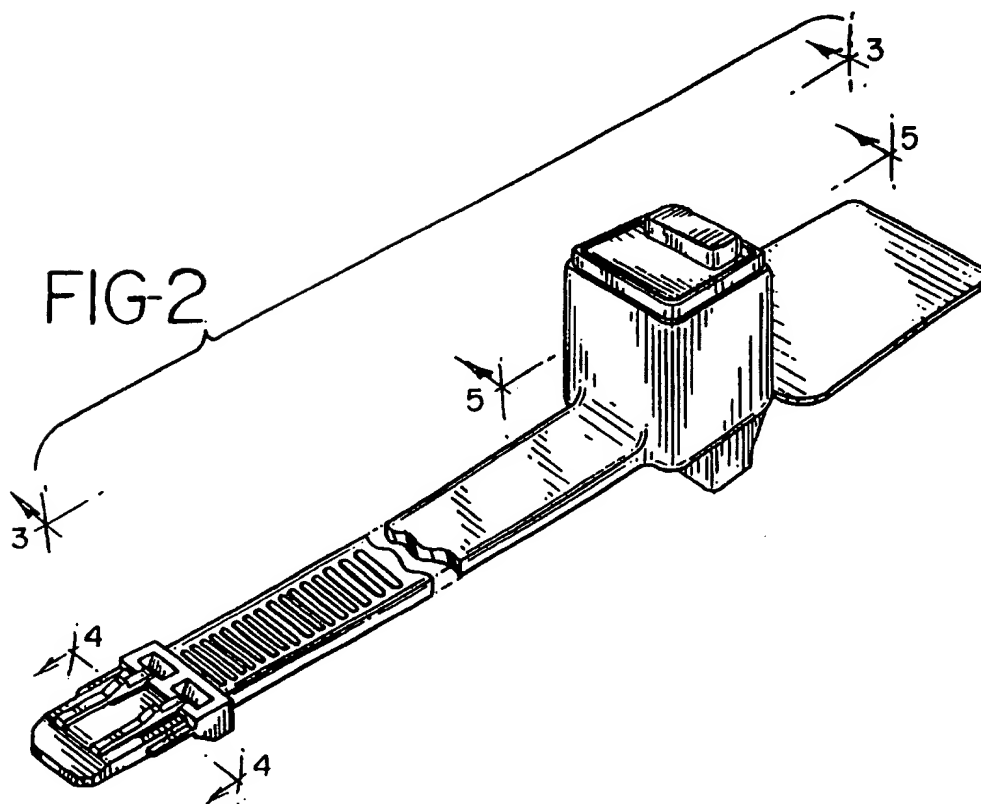


FIG-2





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FIG-3

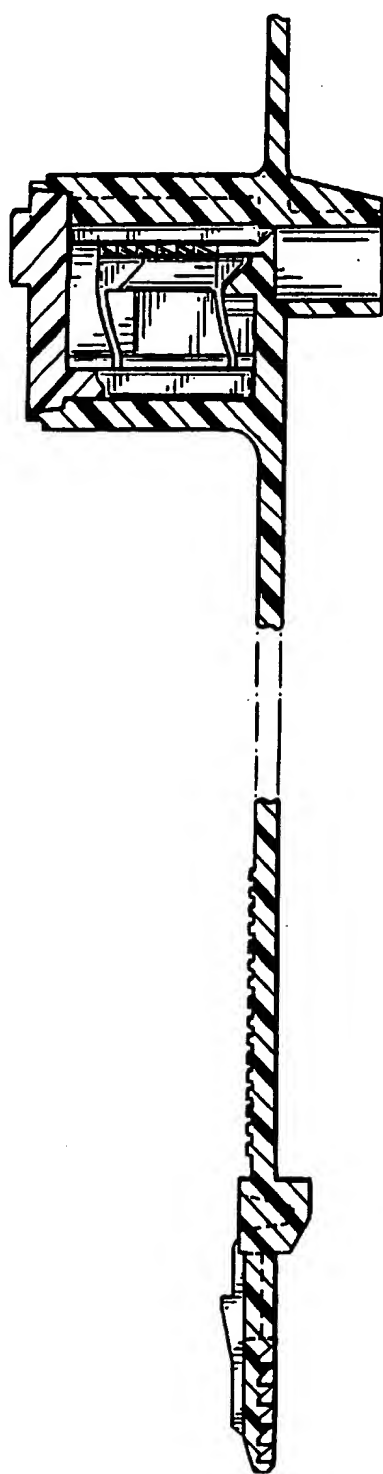


FIG-5

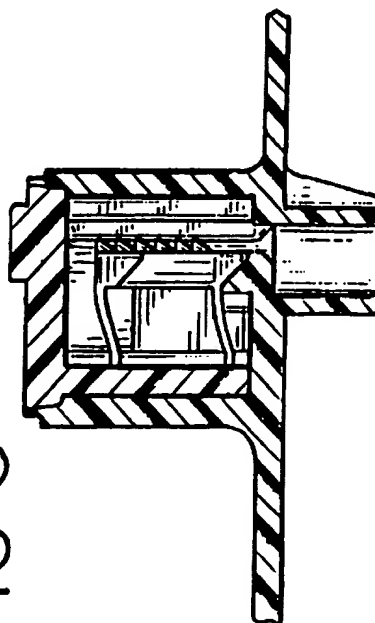
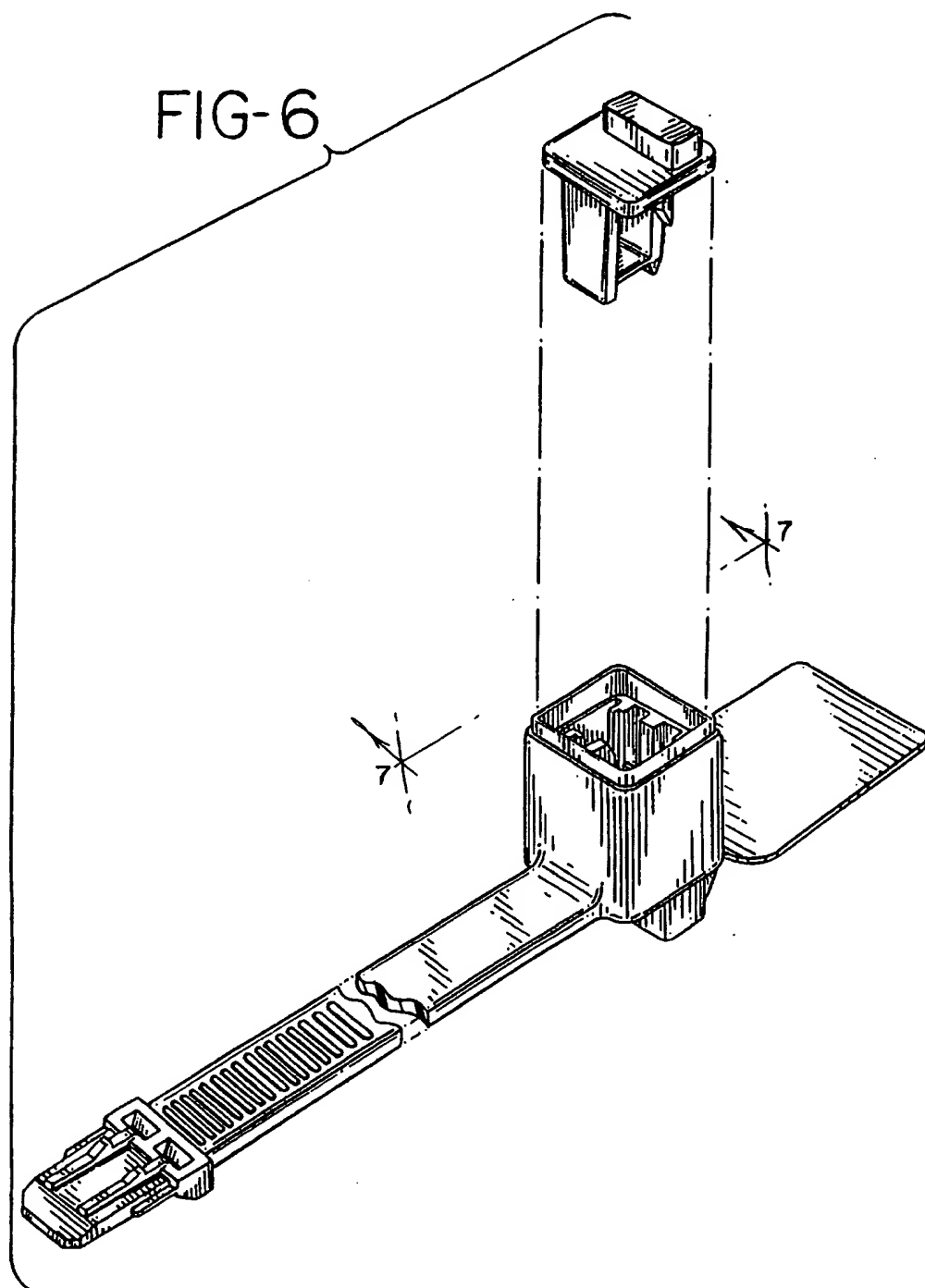


FIG-4



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FIG-7

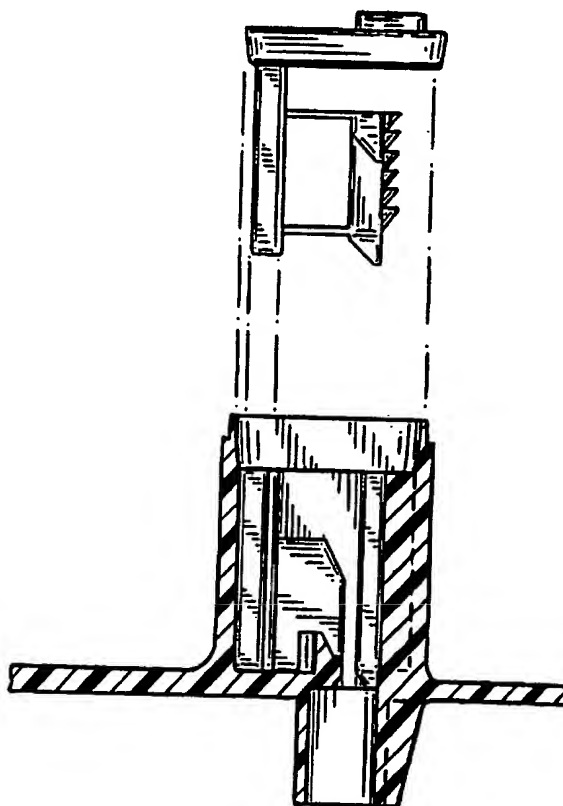


FIG-8

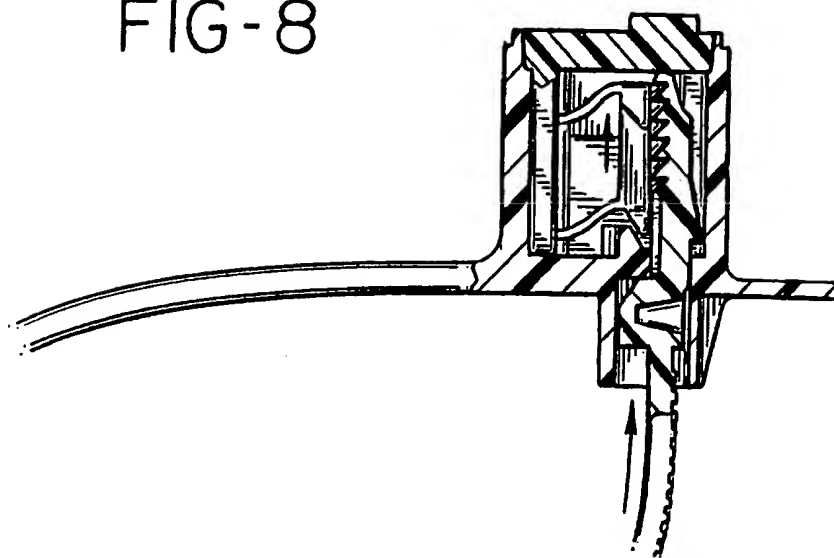


FIG-9

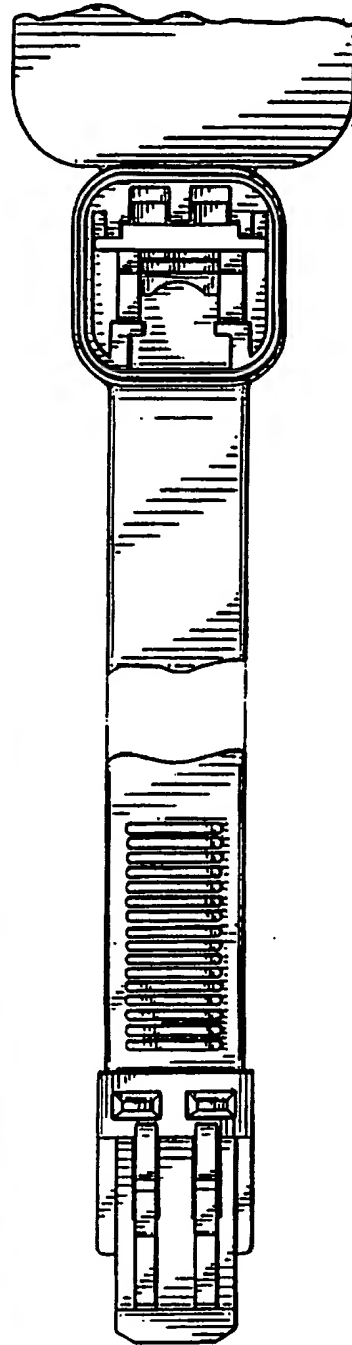
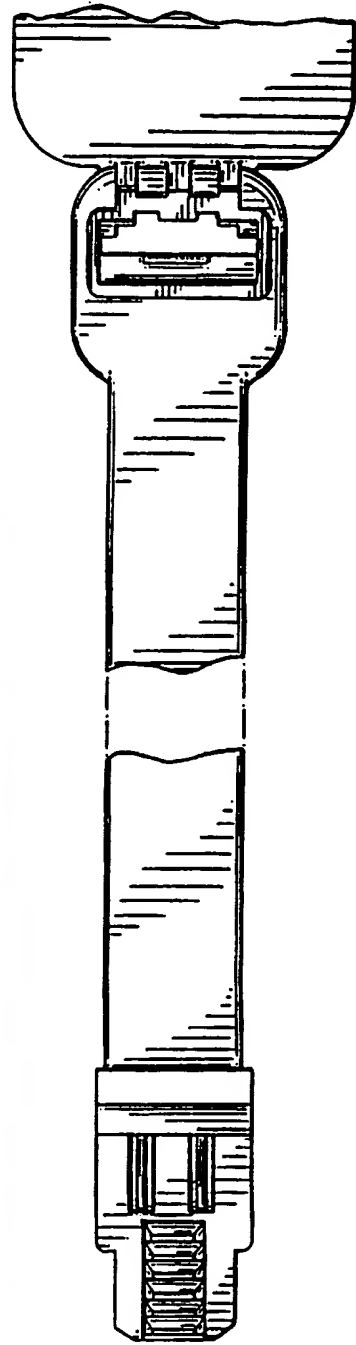


FIG-10



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FIG-11

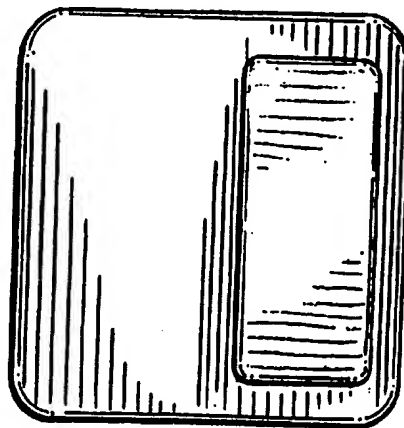


FIG-12

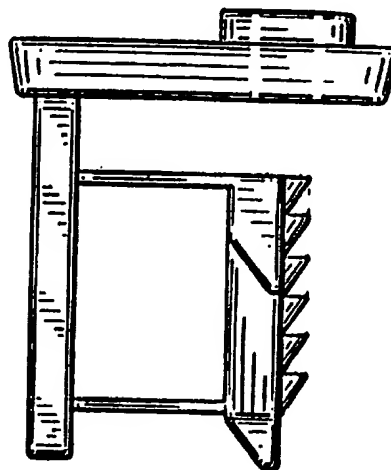
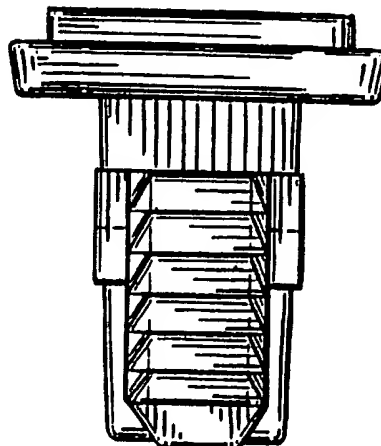


FIG-13



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US95/13117

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : B65D 33/34, 55/06

US CL : 292/307R

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 24/16PB, 17AP, 17B, 30.5, 616, 618; 292/307A, 307R, 317, 318, 319, 325, 331

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	GB, A 2,163,707A (MCCORMICK) 05 March 1986, Figures 1-3.	1-3, 10-13, 18-20 ----- 4-9, 14-17, 21-23
Y	US, A, 925,416 (BATTENBERG) 15 June 1909, Figure 7.	7, 8, 14, 15
Y	US, A, 4,532,679 (SCOTT) 06 August 1985, Figure 6.	4-6, 9, 16, 17, 21-23
X	US, A, 4,676,535 (MAUTNER) 30 June 1987, Figures 8-10.	1, 2, 12, 13, 18, 19, 20, 21, 22

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

18 DECEMBER 1995

Date of mailing of the international search report

31 JAN 1996

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/13117

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4,854,014 (UENO) 08 August 1989, Figures 5 and 6.	1-3, 7, 8, 12-15, 19, 20
A	US, A, 5,123,686 (WENK) 23 June 1992, Figure 3.	1-23